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Published in:
Archives of Physical Medicine and Rehabilitation

DOI:
10.1016/j.apmr.2011.11.030

Publication date:
2012

ORIGINAL ARTICLE

Construct Validity and Test-Retest Reliability of the Walking Questionnaire in People With a Lower Limb Amputation

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ABSTRACT. de Laat FA, Rommers GM, Geertzen JH, Roorda LD. Construct validity and test-retest reliability of the Walking Questionnaire in people with a lower limb amputation. Arch Phys Med Rehabil 2012;93:983-9.

Objective: To investigate the construct validity and test-retest reliability of the Walking Questionnaire, a patient-reported measure of activity limitations in walking in people with a lower limb amputation.

Design: Cross-sectional study.

Setting: Outpatient department of a rehabilitation center.

Participants: People with a lower limb amputation (N=172; mean age ± SD, 65±12y; 71% men; 82% vascular cause) participated in the study, 33 of whom also participated in the reliability study.

Interventions: Not applicable.

Main Outcome Measures: Construct validity was investigated by testing 11 hypotheses: limitations in walking according to the Walking Questionnaire will be greater in people with a lower limb amputation who (1) are older, (2) have a bilateral amputation, (3) have a higher level of amputation, (4) underwent their rehabilitation treatment in a nursing home, (5) walk less (in terms of time), and (6) walk shorter distances. Furthermore, limitations in walking will be positively related to activity limitations according to the (7) Locomotor Capabilities Index, (8) "distance walked" question on the Prosthetic Profile of the Amputee Questionnaire, (9) Questionnaire Rising and Sitting Down, (10) Climbing Stairs Questionnaire, and (11) Special Interest Group on Amputation Medicine/Dutch Working Group on Amputations and Prosthetics mobility scale. Construct validity was quantified by using the Mann-Whitney *U* test and Spearman correlation coefficient. Test-retest reliability was assessed with a 3-week interval and quantified using the intraclass correlation coefficient.

Results: Construct validity (10 of 11 hypotheses not rejected) and test-retest reliability were good (intraclass correlation coefficient =.73; 95% confidence interval, .43–.88).

Conclusions: The Walking Questionnaire has good construct validity and test-retest reliability in people with a lower limb amputation.

Key Words: Amputation; Disability evaluation; Questionnaires; Rehabilitation.

A MAIN GOAL OF REHABILITATION after lower limb amputation is to restore mobility.[1] Mobility is regarded by people with a lower limb amputation as the most relevant ability for their quality of life.[2] An important aspect of mobility is the ability to walk. With an adequate prosthesis and rehabilitation treatment many people with a lower limb amputation are able to improve their ability to walk. This is associated with increased activities of daily living[3] and successful job reintegration.[4]

Many mobility scales have been used to measure limitation in walking,[5] but no criterion standard exists.[5-7] Most scales are based on patient-reported or physician-reported categories of ambulation,[8-11] observation of performance,[12,13] or generic instruments applied to people with a lower limb amputation.[14,15] For assessing perceived limitations in mobility in a patient's home environment, the Locomotor Capabilities Index (LCI)[16-18] is often used. However, the LCI has a high ceiling effect,[19] and only 6 of the 14 questions concern walking.

A patient-reported questionnaire that provides a detailed measurement of limitations in walking inside and outside the house is the Walking Questionnaire.[20] It contains 35 items formulated in behavioral terms with dichotomous response options ("yes" box marked/"yes" box not marked). These items operationalize aspects of walking such as velocity, uncertainty, adaptations, and use of walking aids (eg, I do walk outside, but I walk unsteadily over obstacles). The sum score is calculated by adding the scores for the 35 items. This sum score is subsequently standardized (range, 0–100), with higher scores indicating less limitation in walking. Patients can mark a 36th item if they do not walk inside the house at all. These patients are then given the minimum score. Patients can also mark a 37th item if they do not walk outside the house at all because of their health. These patients are treated as if they had marked the "yes" box for all items concerning walking outside the house. The Walking Questionnaire was tested in 981 home-dwelling patients with lower extremity disorders (including

List of Abbreviations

CI	confidence interval
GRCQ	Global Rating of Change Questionnaire
ICC	intraclass correlation coefficient
LCI	Locomotor Capabilities Index
PPA	Prosthetic Profile of the Amputee
SIGAM	Special Interest Group on Amputation Medicine
SIGAM/WAP	Special Interest Group on Amputation Medicine/Dutch Working Group on Amputations and Prosthetics

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No commercial party having a direct financial interest in the results of the research supporting this article has or will confer a benefit on the authors or on any organization with which the authors are associated.

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In-press corrected proof published online on Mar 19, 2012, at www.archives-pmr.org.

0003-9993/12/9306-00957$36.00/0
doi:10.1016/j.apmr.2011.11.030

239 people with a lower limb amputation). It has (1) good fit with the monotonicity model (or scalability), indicating that the items form a scale; (2) good fit with the double monotonicity model, indicating invariant (hierarchical) item ordering; (3) good intratest reliability, indicating good repeatability of the sum score; (4) good robustness, indicating both stability of scalability and invariant item ordering in subgroups of patients; and (5) some differential item functioning (6 items in amputees, compared with nonamputees), indicating that measurements should be interpreted cautiously when comparisons are made between amputees and nonamputees. Its construct validity and test-retest reliability have not yet been investigated in people with a lower limb amputation.

Therefore, the main objective of this study was to assess the construct validity of the Walking Questionnaire in people with a lower limb amputation. The secondary objective was to assess the test-retest reliability of the Walking Questionnaire in people with a lower limb amputation.

METHODS

Participants

Participants were recruited between 1998 and 2008 in the outpatient department of Rehabilitation Center Tolbrug, 's Hertogenbosch, in The Netherlands. Inclusion criteria were as follows: patients were 18 years or older; they were wearing a prosthesis at the end of their rehabilitation treatment after a recent lower limb amputation; and they were able to understand and fill in the questionnaires. A first group of patients consisted of people with a lower limb amputation from the rehabilitation center (rehabilitation center group). These people with a lower limb amputation were assessed before the start of their follow-up in the outpatient department. A second group consisted of people with a lower limb amputation directly after discharge from their inpatient or outpatient rehabilitation treatment in nursing homes in the region of Tolbrug, 's Hertogenbosch (nursing home group). These people with a lower limb amputation were assessed at the start of their follow-up at the outpatient department of the rehabilitation center. The 2 groups together encompassed all people with a lower limb amputation undergoing rehabilitation treatment in this region. For the test-retest reliability study, a subgroup of people with a lower limb amputation, who had finished their rehabilitation treatment between June 2003 and November 2004, was recruited from the rehabilitation center group.

The study protocol was approved by the Research Ethics Committee of the Jeroen Bosch Hospital, 's Hertogenbosch. All participants gave informed consent.

Procedure

To assess construct validity, all participants received an initial questionnaire consisting of the Walking Questionnaire,[20] a rating scale to measure time walked, a rating scale to measure distance walked, the LCI,[18,21] the "distance walked" question of the Prosthetic Profile of the Amputee (PPA) Questionnaire,[18] the Questionnaire Rising and Sitting Down,[22] and the Climbing Stairs Questionnaire.[23] The subgroup in the reliability study also received the Special Interest Group on Amputation Medicine/Dutch Working Group on Amputations and Prosthetics (SIGAM/WAP) mobility scale.[9] The rehabilitation center group received this initial questionnaire from their therapists on the second-to-last day of treatment. They were asked to complete the questionnaire at home and bring it with them on the last day of treatment. The nursing home group received the questionnaire during their first follow-up appointment in the rehabilitation center. They were asked to complete the questionnaire at home and return it by mail.

To assess test-retest reliability, the previously described subgroup received a second questionnaire consisting of the Walking Questionnaire and 2 self-constructed Global Rating of Change Questionnaires (GRCQs). Study participants received the questionnaire 3 weeks after the initial questionnaire was administered, as this period was considered to be long enough to ensure that the participants would not remember their first responses (recall bias). The GRCQs were used to exclude patients whose limitations in walking had changed significantly in the 3-week period after discharge from treatment. Patient instructions and the items of the GRCQs can be found in appendix 1. Participants were considered to be stable with respect to their limitations in walking if they gave themselves a rating of between 6 and 10 on both GRCQs. Patients were asked to fill in the second questionnaire at home and to return it by mail. People with a lower limb amputation who returned questionnaires with missing data were contacted by telephone by an independent physician and asked to provide the missing data.

Measurements

Data on age, sex, and diagnosis were extracted from each patient's medical record.

To assess the time and distance walked, we used self-developed rating scales (appendix 2). Patients were instructed to rate the maximum time and distance they walk (without stopping) in their daily lives. In addition to these rating scales, patient-reported measurement instruments with a good conceptual framework[19,24] measuring mobility or aspects of mobility in people with a lower limb amputation were selected. These were the LCI,[18,21] the "distance walked" question of the PPA Questionnaire,[18] the Questionnaire Rising and Sitting Down,[22] the Climbing Stairs Questionnaire,[23] and the SIGAM/WAP mobility scale.[9]

The LCI[18,21] is a patient-reported assessment covering a range of locomotor activities, such as rising from a chair or the floor, walking on a variety of surfaces, and climbing stairs and curbs. The LCI is a part of the larger PPA, a questionnaire measuring prosthetic use and factors potentially related to prosthetic use. The LCI consists of 14 items with 4 response options: unable (score 0), able if someone helps me (score 1), able if someone is near me (score 2), or able alone (score 3). The sum scores range from 0 to 42, with higher scores indicating better locomotor capabilities. The construct validity and the test-retest reliability of the LCI have been reported to be good.[16,17]

The "distance walked" question of the PPA Questionnaire[18] has 6 response options ranging from "I do not walk with my prosthesis" (score 0) to "I am not limited in walking" (score 6). This "distance walked" question has been reported to have moderate to substantial reliability.[17]

The Questionnaire Rising and Sitting Down[22,25] is a patient-reported questionnaire measuring activity limitations in rising and sitting down. It contains 39 items with dichotomous response options ("yes" box marked/"yes" box not marked). The sum score is based on the 1-parameter logistic model[22] and is standardized (range, 0–100), with higher scores indicating less limitation. The Questionnaire Rising and Sitting Down is a unidimensional scale. It has good fit with the 1-parameter logistic model, good intratest reliability, and good content validity.[22] Furthermore, the Questionnaire Rising and Sitting Down has good construct validity and test-retest reliability in people with a lower limb amputation.[26]

The Climbing Stairs Questionnaire[23] is a patient-reported questionnaire that measures activity limitations in climbing stairs. It consists of 15 items with dichotomous response options. The sum score is calculated by adding the scores of the 15 items. This sum score is subsequently standardized (range, 0–100), with higher scores indicating less limitation in climbing stairs. Patients can mark a 16th item if they do not climb stairs at all, because of health reasons, whereby they are given the minimum score. The Climbing Stairs Questionnaire has been shown to have good scalability, hierarchical item ordering, and good intratest reliability. Furthermore, the Climbing Stairs Questionnaire has good construct validity and test-retest reliability in people with a lower limb amputation.[27]

The SIGAM/WAP scale[9,10] is used to measure levels of mobility in lower limb amputees. It is a physician-reported or patient-reported questionnaire designed to measure ambulation, using walking aids if necessary. It contains 21 items with dichotomous response options ("yes" box marked/"yes" box not marked). An algorithm has been designed to distinguish between 6 different mobility grades. The Special Interest Group on Amputation Medicine (SIGAM) scale has proven to be a feasible (questions are simple, easy to assess, and not overly time-consuming), reliable, and valid measure.[10] The Dutch version of the SIGAM scale is called the SIGAM/WAP and has been showed to have good intertest reliability.[9]

Analysis

Construct validity. Construct validity indicates the degree to which the scores on a measurement instrument are consistent with theoretically derived hypotheses (eg, with regard to internal relations, relationships to scores of other instruments, or differences in scores between relevant groups), based on the assumption that the instrument validly measures the construct being measured. Construct validity is considered to be good if at least 75% of the hypotheses are not rejected in a study group of at least 50 participants.[28] Based on the available literature regarding the relationship between limitations in walking after rehabilitation and sociodemographic factors in people with a lower limb amputation, 11 hypotheses were formulated before analyzing the study data. We hypothesized that limitations in walking, according to the Walking Questionnaire, would be greater in people with a lower limb amputation who (1) are older[7,16,29]; (2) have a bilateral amputation as opposed to a unilateral amputation[7,30]; (3) have a higher level of amputation (transfemoral or knee disarticulation) as opposed to a lower level of amputation (transtibial or Syme amputation)[7,16]; (4) had undergone rehabilitation treatment in a nursing home as opposed to having received their treatment in an outpatient department of a rehabilitation center[30]; (5) walk shorter distances, according to their rating of distance walked; (6) walk less (in terms of time), according to their rating of time walked; (7) have more limitations in locomotor capabilities, according to the LCI[16]; (8) have more limitations in walking distance, according to the "distance walked" question of the PPA[17]; (9) have more limitations in rising and sitting down, according to the Questionnaire Rising and Sitting Down[22,26]; (10) have more limitations in climbing stairs, according to the Climbing Stairs Questionnaire[23,27]; and (11) have more limitations in walking mobility, according to the SIGAM/WAP mobility scale.[9,10]

Hypotheses addressing relationships (hypotheses 1, 5–11) were quantified using Spearman correlation coefficients, and hypotheses addressing the presence or absence of differences (hypotheses 2–4) were quantified using the Mann-Whitney *U* test (2-tailed $P<.05$).

Test-retest reliability. Test-retest reliability refers to the reproducibility of measurements using the same instrument over time. To assess the reproducibility of the Walking Questionnaire, we used Walking Questionnaire data from the first and second questionnaires of the participants who had rated themselves as being stable on the GRCQ. To estimate the test-retest reliability of the Walking Questionnaire, we calculated the intraclass correlation coefficient (ICC) with 95% confidence interval (CI), using a 2-way mixed model. Patients were considered to be random effects, while the measurement effect was considered to be a fixed effect. An ICC of at least .70 was considered to be satisfactory for group comparisons, whereas an ICC of at least .90 was considered to be satisfactory for individual comparisons.[28] To visualize the agreement, we represented the data graphically in a Bland-Altman plot.[31] All statistics were calculated using SPSS 15.0 for Windows.[a]

RESULTS

Patient Characteristics

The inclusion criteria were met by 175 people with a lower limb amputation, of whom 172 were willing to participate in the construct validity study. Two people with a transtibial amputation and 1 person with a knee disarticulation, all from the rehabilitation center group, were unwilling to participate. Characteristics of the 172 people with a lower limb amputation are listed in table 1. Only 12 of the 172 participants had bilateral lower limb amputation.

Of the 172 people with a lower limb amputation who participated in the construct validity study, 35 met the additional selection criteria for the test-retest reliability study. Of these 35 people with a lower limb amputation, 2 were unwilling to fill in the second questionnaire; 1 had a transtibial amputation and 1 had a transfemoral amputation. The resulting data therefore

Table 1: Patient Characteristics (N=172)

Characteristics	Values
Age (y)	65±11 (37–92)
Sex	
Women	50 (29)
Men	122 (71)
Amputation etiology	
Vascular	143 (83)
Infection	13 (8)
Traumatic	13 (8)
Oncologic	3 (2)
Amputation level, unilateral, total	160 (93)
Hip disarticulation	3 (2)
Transfemoral	55 (32)
Knee disarticulation	8 (5)
Transtibial	93 (54)
Syme	1 (1)
Amputation level, bilateral, total	12 (7)
Transfemoral and transtibial	2 (1)
Transtibial and transtibial	7 (4)
Syme and transtibial	3 (2)
Setting	
Rehabilitation center	155 (90)
Nursing home	17 (10)

NOTE. Values are mean ± SD (range) or n (%).

Table 2: Construct Validity of the Walking Questionnaire in People With a Lower Limb Amputation

Hypothesis*	n	Spearman Correlation Coefficient	$P^{\dagger}$	Standardized Median (IQR) Sum Score	$P^{\ddagger}$
1. Age	172	−.18	<.05		
2. Amputation	172				.30
Bilateral	12			33 (19–68)	
Unilateral	160			47 (25–72)	
3. Amputation level[§]	160				<.05
Higher (transfemoral or knee disarticulation)	66			40 (22–67)	
Lower (transtibial or Syme amputation)	94			58 (32–77)	
4. Setting	172				<.001
Nursing home	17			19 (3–40)	
Rehabilitation center	155			50 (31–75)	
5. Time walked rating scale	172	−.47	<.001		
6. Distance walked rating scale	172	−.39	<.001		
7. Locomotor capabilities according to the LCI	164	.50	<.001		
8. Distance walked according to the PPA	172	.46	<.001		
9. Limitation in rising and sitting down	171	.57	<.001		
10. Limitation in climbing stairs	172	.60	<.001		
11. SIGAM/WAP score	34	.37	<.05		

Abbreviation: IQR, interquartile range.
*Eleven hypotheses were tested. Limitations in walking, according to the Walking Questionnaire, will be greater in people with a lower limb amputation who (1) are older; (2) have a bilateral amputation than in people with a unilateral lower limb amputation; (3) have a higher level of amputation than in people with a lower level of lower limb amputation; (4) had undergone rehabilitation treatment in a nursing home compared with people with lower limb amputation who had received their treatment in a rehabilitation center; (5) walk less (in terms of time), according to their rating scale of time walked; (6) walk shorter distances, according to their rating scale of distance walked; (7) have more limitations in locomotor capabilities, according to the LCI; (8) walk shorter distances, according to the PPA "distance walked" question; (9) have more limitations in rising and sitting down, according to the Questionnaire Rising and Sitting Down; (10) have more limitations in climbing stairs, according to the Climbing Stairs Questionnaire; and (11) have more limitations in walking mobility, according to the SIGAM/WAP mobility scale.
†Significance (2-tailed *P* value) of Spearman correlation coefficient.
‡Significance (2-tailed *P* value) of Mann-Whitney *U* test (dichotomous variables).
§People with unilateral lower limb amputation only.

concerned 33 people with a lower limb amputation, only 22 of whom considered themselves to be stable with regard to their limitation in walking.

Construct Validity

Results of the hypotheses that we tested are listed in table 2. Hypothesis 2 (bilateral vs unilateral amputation) was rejected, but the other 10 hypotheses were not. Despite the small number of patients (34), we also found a relationship between limitations in walking as measured by the Walking Questionnaire, and limitations in walking mobility as assessed with the SIGAM/WAP mobility scale.

Test-Retest Reliability

Mean scores ± SD for the first and second Walking Questionnaire assessments were 52±30 and 55±29, respectively. The 3-week test-retest reliability of the Walking Questionnaire was good, with an ICC of .73 (95% CI, .43–.88). Agreement is shown graphically in the Bland-Altman plot (fig 1). Although overall agreement between measurements was acceptable, we found a large difference for 1 lower limb amputee.

DISCUSSION

The objective of this study was to assess the construct validity and test-retest reliability of the Walking Questionnaire in people with a lower limb amputation. We showed that the Walking Questionnaire has good construct validity and good test-retest reliability for group comparisons in people with a lower limb amputation. There are several other questionnaires assessing walking in people with a lower limb amputation, with good clinimetric properties[8-13,15-18]; however, unlike the Walking Questionnaire, they do not provide detailed measurements of perceived limitations in walking.

The number of dropouts in our study was low. Only 3 of the 175 people with a lower limb amputation who fulfilled the selection criteria were unwilling to participate in the validity study. Furthermore, only 2 of the 35 people with a lower limb amputation were unwilling to participate in the reliability study. In addition, with respect to mean age and cause and level of amputation, our sample of people with a lower limb amputation was similar to other cohorts of people with a lower limb amputation in The Netherlands.[32,33]

The construct validity of the Walking Questionnaire in people with a lower limb amputation was good, since only 1 of our 11 hypotheses was rejected. We found no relation between limitation in walking, according to the Walking Questionnaire, and unilateral versus bilateral amputation (hypothesis 2). This was probably because of the small number of bilateral amputees (n=12) in the study and the selection criteria that required the people with a lower limb amputation to wear a prosthesis. Therefore, the selected bilateral amputees may have had fewer activity limitations. The SIGAM/WAP was not available at the start of the study. Hence, data were only available for a subgroup of the participants. This was gathered by an independent physician just after the SIGAM/WAP was made available in The Netherlands.

The test-retest reliability of the Walking Questionnaire in people with a lower limb amputation was good. The test-retest reliability of the Walking Questionnaire has also been studied in patients with complex regional pain syndrome type 1. These patients showed a slightly higher ICC (.78–.84) when com-

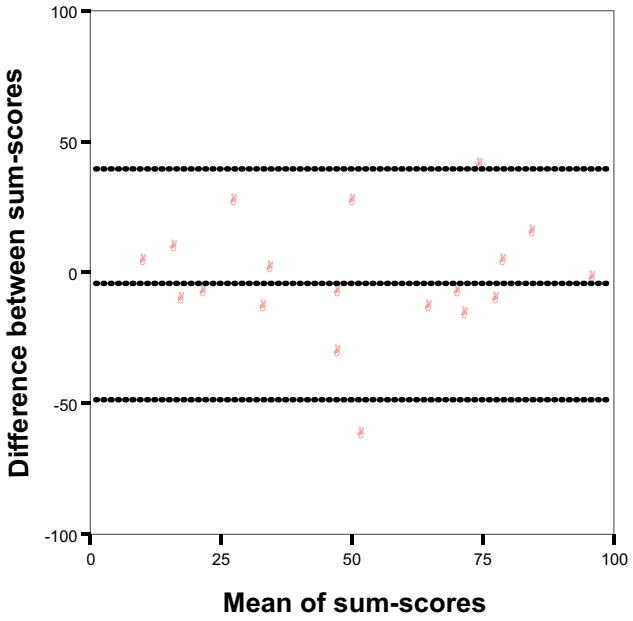

Fig 1. Bland-Altman plot with difference between sum scores of the first and second assessments of the Walking Questionnaire against the mean of sum scores. The dashed horizontal lines show the mean difference and the 95% limits of agreement.

pared with the patients in our study (.73), which may have been attributable to the shorter test-retest interval (1wk) used in that study.[34]

Study Limitations

One limitation of our study is that the nonresponse rate of the people with a lower limb amputation treated in nursing homes was unknown. Only people with a lower limb amputation who had a first follow-up appointment at the outpatient rehabilitation center, after their rehabilitation treatment in a nursing home, were invited to participate in the study. Nevertheless, all the people with a lower limb amputation who attended this appointment were willing to participate.

Another limitation of our study is that we had only 12 people with a bilateral lower limb amputation in our study. Therefore, we were not able to distinguish between people with a unilateral or bilateral lower limb amputation, although people with a bilateral lower limb amputation would probably experience more limitations in walking because of using 2 prostheses.

A third limitation of our study is that the people with a lower limb amputation were selected at the end of their multidisciplinary rehabilitation treatment. At that stage, only 22 of the 33 participants in the reliability study considered their condition as being stable with respect to limitations in walking. The reasons for this were not investigated in the present study. For participants who reported their limitations in walking as being unstable, we suggest that one of the main reasons could be that atrophy of the stump could lead to an ill-fitting socket. Stump atrophy can continue for up to 2 years after amputation.[35] Furthermore, recent standards recommend that at least 50 participants be included in a test-retest reliability study.[28] Therefore, we recommend that future research should replicate our study in a much larger sample, composed of experienced prosthesis users who are unlikely to experience further stump atrophy.

Finally, we only used patient-reported measurement instruments to assess the construct validity of the Walking Questionnaire. We chose this strategy because performance tests are not necessarily strongly related to perceived limitations.[36,37] However, we recommend that the construct validity of the Walking Questionnaire should be further assessed with data from biomechanical and performance-based measures of people with a lower limb amputation. Such measures could include the ability to stand on 1 leg,[7] timed walk tests,[12,38] or examination of the relationship between the Walking Questionnaire and ambulatory activity monitors.[37,39]

CONCLUSIONS

The Walking Questionnaire provides a detailed assessment of patient-reported limitations in walking. It has good construct validity and test-retest reliability in people with a lower limb amputation directly after their multidisciplinary rehabilitation treatment. Based on the results of our reliability study, the Walking Questionnaire is suitable for group comparisons but not for individual comparisons.

APPENDIX 1: THE GLOBAL RATING OF CHANGE QUESTIONNAIRES

(1) How do you rate your ability to walk inside your house now, compared with the first time you filled in the questionnaire?

(2) How do you rate your ability to walk outside your house now, compared with the first time you filled in the questionnaire?

Response options:	YES
1. extremely good	☐
2. very much better	☐
3. much better	☐
4. better	☐
5. somewhat better	☐
6. slightly better	☐
7. almost the same; marginally better	☐
8. no change	☐
9. almost the same; marginally worse	☐
10. slightly worse	☐
11. somewhat worse	☐
12. worse	☐
13. much worse	☐
14. very much worse	☐
15. extremely bad	☐

APPENDIX 2: RATING SCALES OF TIME AND DISTANCE WALKED

What is the maximum time in succession that you actually walk in your daily life?

	YES
1. I walk 2 hours or more	☐
2. I walk 1 hour	☐
3. I walk 30 minutes	☐
4. I walk 15 minutes	☐
5. I walk 7 or 8 minutes	☐
6. I walk 4 minutes	☐
7. I walk 2 minutes	☐

APPENDIX 2 (Cont'd)

	YES
8. I walk 1 minute	☐
9. I walk half a minute	☐

What is the maximum distance in succession that you actually walk in your daily life?

	YES
1. I walk 8 kilometers or more	☐
2. I walk 4 kilometers	☐
3. I walk 2 kilometers	☐
4. I walk 1 kilometer	☐
5. I walk 500 meters	☐
6. I walk 250 meters	☐
7. I walk 125 meters	☐
8. I walk 50 meters	☐
9. I walk 25 meters	☐
10. I walk 12 meters	☐
11. I walk 6 meters	☐
12. I walk a couple of meters	☐

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